REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1-16 are pending, with Claims 1, 6, 9, 10 and 14 amended by the present amendment.

In the Official Action, Claim 9 was objected to under 37 C.F.R. § 1.75(c); Claims 1-4, 6-8, 10 and 14 were rejected under 35 U.S.C. § 102(e) as being anticipated by Okumura et al. (U.S. Patent Publication 2005/0193318, now U.S. Patent 7,194,674, hereinafter Okumura); and Claims 5, 11-13 and 15-16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Okumura.

Claim 9 is amended to comply with 37 C.F.R. § 1.75(c). Claims 1, 6, 10 and 14 are amended to more clearly describe and distinctly claim Applicants' invention. Support for this amendment is found in Applicants' originally filed specification. No new matter is added.

Briefly recapitulating, Claim 1 is directed to a signal evaluation method configured to evaluate a reproduction equalization signal reproduced from a recording medium by use of a PRML (partial response and maximum likelihood) discrimination method, said method comprising the steps of detecting matching between discrimination data and a plurality of predetermined bit pattern pairs of different groups; calculating a bit pattern and corresponding two ideal responses when the matching is detected; obtaining Euclidean distances between the two ideal responses and equalization reproduced signals; obtaining a difference between the Euclidean distances; obtaining a mean value and a standard deviation with respect to the difference between the Euclidean distances; calculating a miss-discrimination probability F(0) of the predetermined bit pattern from the mean value and the standard deviation; and calculating a quality evaluation value of a reproduction signal based

on the miss-discrimination probability F(0), an appearance probability of the predetermined bit pattern, and a Hamming distance between the predetermined bit pattern pairs.

Claims 6, 10 and 14 are directed to devices and methods, each reciting components and steps for calculating a miss-discrimination probability F(0) of the predetermined bit pattern from the mean value and the standard deviation; and calculating a quality evaluation value of a reproduction signal based on the miss-discrimination probability F(0), an appearance probability of the predetermined bit pattern, and a Hamming distance between the predetermined bit pattern pairs.

Okumura describes a device configured to adaptively equalize a waveform of a Viterbi-decodable input signal pattern. The device includes an FIR filter for generating an equalized signal pattern; a Viterbi decoder for detecting a path metric difference between a correct path and error path; a target value register for setting a target value for the path metric difference, and a tap coefficients update circuit for adapting the equalization according to an error of the detected path metric difference from the target value.[1]

The discussion of the background in Okumura describes that jitter has been often used to evaluate reproduced signal quality on an optical disc. Okumura further notes that PRML is a data detection method for realizing higher density storage. With PRML, jitter is not suitable as an evaluation value. Instead, a bit error rate that has been obtained by PRML is used as the evaluation value. However, this evaluation value requires a large number of sample bits for a measurement, and defects on the disk tend to influence the evaluation accuracy. Okumura notes an evaluation method, called SAM (Sequenced Amplitude Margin), has been proposed To address these issues.[2]

SAM is described FIGS. 21 and 22 of Okumura, where a reproduced signal of a bit pattern that has been recorded on the basis of d=1 (1, 7) RLL (Run Length Limited) Coding is

[1] Okumura, paragraph [0043].
[2] Okumura, paragraphes [0018-0019].

decoded in PRML, in accordance with PR (1, 2, 1) properties. As shown in FIG. 21, a reproduced waveform in accordance with PR(1,2,1) properties has an ideal 1T mark free from any distortion or noise has a 1:2:1 level ratio of samples for a channel clock. For a reproduced waveform from a 2T or more mark, a level ratio is obtainable from the superimposition of the reproduced waveform from a 1T mark. For example, the sample level ratio is 1:3:3:1 for the 2T mark, 1:3:4:3:1 for the 3T mark, and 1:3:4:4:3:1 for the 4T mark. An ideal reproduced waveform can be assumed for any given bit pattern. There are five ideal sample levels (ideal sample levels): 0, 1, 2, 3, and 4.[3]

In Okumura, Viterbi decoding is adopted for PRML decoding. The Viterbi decoding is described as follows with reference to a trellis diagram shown in FIG. 22. In FIG. 22, S(00), S(01), S(10), and S(11) each represents a different state: for example, the state S(00) means a 0 previous bit and a 0 current bit. A line linking a state to the other is termed a "branch," which represents a state transition: for example, a branch of S(00)-S(01) represents a "001" bit pattern. Here, the S(01)-S(10) and S(10)-S(01) branches are missing from the diagram. This is because the 010 and 101 bit patterns cannot occur due to the d=1 (1,7) RLL. Each letter of α to ξ is allocated to each branch as an identifier, and an ideal waveform level expected at each state transition follows the identifier. In PR (1, 2, 1), an ideal waveform level is determined by three successive bits: v0. v1, and v2, and a value of the ideal waveform level is calculated by v0+2v1+v2. For example, when a represents a "000" bit pattern, the ideal level is 0, and when β represents a "100" bit pattern, the ideal level is 1.[4]

In the trellis diagram, a "path" is formed by connecting continuous branches between the states. To consider all the paths generated after transiting from any one state to another means to consider all the possible bit patterns. The most likely path, or the "correct path," can be determined by comparing the waveform actually reproduced from the optical disc with

[3] Okumura, paragraphes [0020-0021].
[4] Okumura, paragraphes [0022-0023].

every ideal waveform derived from the paths to find the ideal waveform that is the "closest" to the reproduced waveform (that is, the one with the least Euclidean distance from the reproduced waveform.) [5]

However, contrary to the Official Action[6], Okumura does not disclose or suggest Applicants' claimed calculating a Hamming distance, let alone Applicants' claimed calculating a miss-discrimination probability F(0) of the predetermined bit pattern from the mean value and the standard deviation; and calculating a quality evaluation value of a reproduction signal based on the miss-discrimination probability F(0), an appearance probability of the predetermined bit pattern, and a Hamming distance between the predetermined bit pattern pairs.

By way of background, the following analysis is provided to explain the differences between Applicants' claimed Hamming Distance and the Path Metric Difference of Okumura. For example, assume that the predetermined bit pattern pair is as follows: Pattern A: 11000 ; and Pattern B: 11100. The Hamming Distance refers to the number of different bits between two patterns. In this case, the Hamming Distance between Patterns A and B is 1. Assume that PR (1, 2, 1) is used in PR class (in accordance with the reference). In this case, an ideal response to each of Patterns A and B is as follows: Ideal Response A: 13310; and Ideal Response B: 13431. Assume that a real equalization reproduced signal has the following contents: Real Equalization Reproduced Signal: [0.8 2.5 3.5 2.5 0.5].

In this case, the Euclid distance between the real equalization reproduced signal and the ideal response A and the Euclid distance between the real equalization reproduced signal and the ideal response B are expressed by the following formulas:

Euclid Distance A= $\sqrt{\{(1-0.8)^2+(3-2.5)^2+(3-2.5)^2+(1-2.5)^2+(0-0.5)^2\}}=\sqrt{3.04}$

[5] Okumura, paragraph [0024].
[6] Official Action, page 3, lines 13-15.

Euclid Distance B= $\sqrt{\{(1-0.8)^2+(3-2.5)^2+(4-3.5)^2+(3-2.5)^2+(1-0.5)^2\}}=\sqrt{1.04}$

In this case, the square of the Path Metric Difference is calculated as 3.04-1.04=2.00. Thus, contrary to the Official Action the Hamming Distance and the Path Metric Difference are clearly different.

In Applicants' invention, the evaluation value calculated in the reference can express the probability that Pattern B is misidentified as Pattern A, but is insufficient to express to what extent the bit error rate is affected. In order to express to what extent the bit error rate is affected by the misidentification of Pattern B as Pattern A, the occurrence probability of Pattern B and how many bits become bit errors as a result of one misidentification (Hamming Distance) are further required. The present invention enables the evaluation of the degree of effect on the bit error rate by using occurrence probability of a predetermined pattern and the Hamming Distance. No such benefit is possible with Okumura.

For at least the forgoing reasons, Okumura does not disclose or suggest Applicants' claimed calculating a Hamming distance, let alone Applicants' claimed calculating a miss-discrimination probability F(0) of the predetermined bit pattern from the mean value and the standard deviation; and calculating a quality evaluation value of a reproduction signal based on the miss-discrimination probability F(0), an appearance probability of the predetermined bit pattern, and a Hamming distance between the predetermined bit pattern pairs.

MPEP § 2131 notes that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). See also MPEP § 2131.02. "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Because Okumura does not

disclose or suggest all the features recited in Claims 1, 6, 10 and 14, Okumura does not anticipate the invention recited in Claims 1, 6, 10 and 14, and all claims depending therefrom.

Regarding Claim 2, the Official Action asserts "wherein said quality evaluation signal is used as a first evaluation value (paragraph 027)". For the reasons described above, this assertion is traversed. Furthermore, the Official Action states that the reference describes "a second evaluation value based on the autocorrelation of said equalization error is used as an evaluation value for the signal quality (paragraph 0006 and 0043)." However, the paragraphs identified in the Official Action read as follows:

> [0006] FIG 14 is a block diagram illustrating the structure of a conventional waveform equalizing device 50. The waveform equalizing device provided with an FIR filter (Finite impulse response filter) 52 with 3 taps (equalization coefficient or tap coefficient = c(k,i) where k = 0,1,2), an LMS calculator circuit 53, and an ideal signal waveform generating Circuit 54. The waveform equalizing device 50 equalize a reproduced waveform to an ideal signal waveform assumed in PR class by obtaining equalization errors from the two waveforms by LMS and adaptively varying equalization properties to reduce the equalization errors.
>
> [0043] In order to achieve the first object, the waveform equalizing device of the present invention which adaptively equalizes a waveform of a Viterbi-decodable input signal pattern includes: an FIR filter for generating an equalized signal pattern on the basis of equalization of a waveform of the input signal pattern; a Viterbi decoding circuit for detecting a path metric difference between a correct path and an error path in Viterbi decoding based on the equalized signal pattern; a target value register for setting a target value for the path metric difference; and a tap coefficients update circuit for adapting the equalization according to an error of the detected path metric difference from the target value.

Contrary to the Official Action, there is no description about an evaluation value based on an autocorrelation of equalization errors in Paragraphs [0006] and [0043] of Okumura.

Applicants also traverse the rejection of Claims 3-4. The Official Action asserts that "the third evaluation value being provided by an error correction decoder ("Viterbi decoder"). However, Applicants' claimed "error correction decoder" refers to a decoder of an error-correcting code, where the points and the number of errors can be determined by an error correction processing. On the other hand, a "Viterbi decoder" is a binarizer. Points and the

number of errors cannot be determined with a Viterbi decoder. That is, the Viterbi decoder of Okumura cannot be used in place of Applicants' claimed error correction decoder.

Applicants also traverse the rejection of Claims 7 and 8. The Official Action asserts that the features of Claims 7 and 8 are found in paragraph [0264] of Okumura. However, paragraph [0264] of Okumura reads as follows:

> [0264] Thus, the optical disc reproducing device 101 can evaluate the quality of the Viterbi-decodable digital signal by means of the signal quality evaluation section 110 without using a Viterbi decoding circuit. Further, the optical disc reproducing device 101 can control the quality of the digital reproduced signal in accordance with the result of evaluation of the digital reproduced signal that has been output by the signal quality evaluation section 110.

Nothing in this paragraph relates to adjusting a recording waveform by use of a value calculated based on the mean value and the standard deviation, as recited in Applicants' Claim 7. Similarly, nothing in this paragraph relates to performing at least one of: adjustment of a recording waveform; an offset adjustment of a reproduction signal; gain adjustment; adjustment of an equalization coefficient; tracking control; focusing control; tilting control; and the adjustment of a spherical aberration, as recited in Applicants' Claim 8.

Accordingly, in view of the present amendment and in light of the previous discussion, Applicants respectfully submit that the present application is in condition for allowance and respectfully request an early and favorable action to that effect.

Respectfully submitted,

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